

## Unitary correlation in nuclear reaction theory

A. M. Mukhamedzhanov and A. S. Kadyrov<sup>1</sup>

<sup>1</sup>*Curtin University of Technology, GPO Box U1987, Perth, WA 6845, Australia*

Since the dawn of nuclear physics ( $d,p$ ) reactions have been the main tool to extract spectroscopic factors (SFs) (we call them phenomenological SFs), which were compared with predictions of the independent-particle shell model (IPSM). Later on electron-induced breakup reactions and nucleon knockout reactions became new tool to determine the SFs. Reduction of the phenomenological SFs deduced from the  $(e,e'p)$  reactions compared to the IPSM ones has been discussed in [1]. Recently a similar reduction has been observed for the SFs determined from the analysis of the single-nucleon knockout nuclear reactions [2].

Although the reason for this reduction is not yet known, there are different possible sources of this reduction: the single-particle approximation of the overlap function, antisymmetrization effects, ambiguity of the optical potentials, accuracy of the DWBA, contribution of the coupled channels, the effect of the short-range NN correlations. A very interesting observation has been pointed out in [3]. The reduction of the SFs can be explained if they are calculated as the square of the norm of the overlap functions found from the inhomogeneous equation, which contains the correlation-dependent effective nucleon-nucleon potential.

In the IPSM the model wave functions are given by the linear combination of the Slater determinant wave functions. However, such model wave functions don't take into account short-range NN correlations caused by the repulsive core in the NN potential. In [4] the Unitary Correlation Operator Method (UCOM) has been developed, which allows one to correct the IPSM by taking into account the short-range repulsive NN correlations by applying unitary correlation operators (UCOs) onto the trial functions. In this work we consider the impact of the short-range NN correlations on  $(d,p)$ ,  $(d,pn)$  and  $(e,e'p)$  reactions. Using the surface integration we have proved that the exact reaction amplitude for the  $(d,p)$ , and  $(d,pn)$  and reactions is invariant under finite-range unitary correlations while the SFs are not. It makes impossible unambiguous determination of the SFs from  $(d,p)$ , and  $(d,pn)$  reactions if the exact approach is used.

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